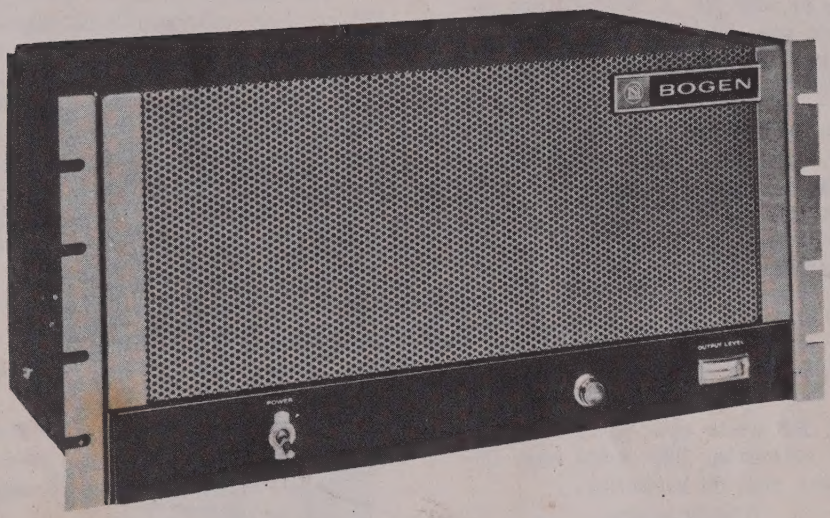
BOGEN®



MODEL NTB250
250-350 WATT
SILICON TRANSISTOR
BOOSTER AMPLIFIER

LEAR SIEGLER, INC.
LSi®
BOGEN DIVISION
P.O. BOX 500
PARAMUS, N. J. 07652

MP MASTER
MA30159

INSTALLATION AND OPERATING MANUAL

READ THOROUGHLY BEFORE OPERATING EQUIPMENT

GENERAL DESCRIPTION

The Bogen Model NTB250 is a high-power booster amplifier designed to deliver up to 350 watts of output power. This high-quality amplifier has exceptional power handling capability over its entire range, and is especially recommended for industrial plants, stadiums, and similar installations where unfailing performance and high output are imperative.

The Model NTB250 Amplifier provides an output of 250 watts rms at less than 3% distortion over the frequency range of 40 to 5000 Hz. A 350-watt rms output is provided at less than 5% distortion between 50 and 12,000 Hz. The frequency response of the unit is ±1 db from 20 to 30,000 Hz.

In addition to 8-ohm, 25-volt and 70-volt output terminals on the rear of the amplifier, a polarized output receptacle provides a source of 120-volt AC power at selected frequencies. Feedback paralleling provisions permit two or more amplifiers to be paralleled for increased power output.

The booster amplifier accepts either high-impedance or low-impedance inputs. Plug-in transformers are available for use with 500/600-ohm or 10,000-ohm impedance inputs.

A power switch, power indicator and output level meter are provided on the front panel. A level control is located on the rear panel, and a speech filter switch on the top chassis selects the optimum response for speech or music programs.

The booster amplifier operates from either a 105-125 vac line or from a 24 vdc source. A three-wire line cord provides automatic grounding when connected to a three-prong receptacle. Power consumption is 150 watts at no signal and 700 watts at maximum 350 watts audio output. A 10-amp circuit breaker and a 40-amp fuse protect the ac and dc lines, and two 20-amp fuses safeguard the output transistors.

The amplifier is furnished with two attaching brackets for mounting the unit in a standard rack cabinet.

TECHNICAL SPECIFICATIONS

*__POWER OUTPUT:__ 350 watts rms, 50-12,000 Hz @ less than 5% distortion; 250 watts rms, 35-20,000 Hz @ less than 5% distortion.

__PEAK POWER OUTPUT:__ 700 watts.

__POWER GAIN:__ 70 db at 250 watts.

__FREQUENCY RESPONSE:__ ±1 db from 20 to 30,000 Hz.

__REGULATION:__ Better than 2 db from no load to full load.

__SENSITIVITY:__ High-impedance, 1.4 volts for 250 watt output, 1.8 volts for 350 watt output. Low-impedance balanced .32 volts for 250 watt output, .38 volts for 350 watt output.

__NOISE LEVEL:__ -83 db below 250 watts, -85 db below 350 watts.

__INPUT CONNECTIONS:__ High-impedance, two RCA phono jacks. Low-impedance, screw terminals.

__INPUT IMPEDANCES:__ High-impedance, 70,000 Ω. Low-impedance 10,000 Ω (with TL10K plug-in transformer), 500/600 Ω (with TL600 plug-in transformer).

__OUTPUT CONNECTIONS:__ 8 Ω 25 V, 70 V terminals (barrier strip). 120 vac power (polarized receptacle).

__OUTPUT IMPEDANCES__ (Balanced or Unbalanced): At 0.625 Ω (25VCT), 2.5 Ω (25V), 8 Ω (44.7V), 5 Ω (70 VCT), 20 Ω (70 V), 57 Ω (120 V) at 250 watts. 14.3 Ω (70 V), 8 Ω (53 V) at 350 watts.

__CONTROLS AND INDICATORS:__ Power switch, power-on indicator, output level meter on front panel. Speech filter switch and input level control on rear panel.

__POWER REQUIREMENTS:__ 105-125 vac, 50/60 Hz, 20 - 30 vdc, 22 - 32 amp.

__LINE CORD:__ Three-wire type SJ with three-prong grounded plug.

__AUXILIARY RECEPTACLE:__ Three-wire grounded, rated 600 watts at 120 volts.

__POWER CONSUMPTION:__ 150 watts at no signal. 700 watts at 350 watts audio output.

__FUSES AND CIRCUIT BREAKERS:__ 10-amp breaker for ac line, 40-amp fuse for dc line, two 20-amp fuses for output transistors.

__TEMPERATURE RANGE:__ -20°C (-4°F) to +70°C (+158°F).

__SEMI-CONDUCTORS__ (All sillicon except level indicator rectifier): 18 output transistors, 10 low-level transistors, 1 differential transistor, 4 stabistor diodes, 7 rectifier diodes, 2 Zener diodes.

__DIMENSIONS:__ 17-1/8'' wide (19'' with brackets) x 9-1/4'' high x 11-3/4'' deep.

__RACK PANEL MOUNTING:__ Side brackets furnished for mounting on 8-3/4'' x 19'' panel. Forced air cooling recommended when mounted in enclosed rack cabinet.

__FINISH:__ Gray metalustre panel, black chassis.

__WEIGHT:__ Shipping 75 lbs.

*Normal production variations in performance characteristics will not exceed 1 db.

INSTALLATION

UNPACKING

The NTB250 Booster Amplifier was carefully checked before leaving the factory. Inspect shipping container and amplifier carefully for indications of improper handling in shipment. If the unit has been damaged, make an immediate claim to the dealer or distributor from whom it was purchased. If the amplifier was shipped to you, notify transportation company without delay and file a claim.

CONNECTIONS BETWEEN COMPONENTS

For high-impedance inputs, use single-conductor, low-capacity shielded wire for connecting preamplifier to amplifier. Keep leads under ten feet in length, unless emitter follower output is employed.

Speakers may be connected with standard flexible line cord (zip-cord); and up to 100 feet of cable may be used without appreciable loss.

Make certain that all input cables are kept away from speaker cables, power cables, and power transformers, and that speaker cables are kept away from power cables.

POWER AND GROUNDING

Plug the line cord into a three-wire grounded outlet providing a nominal 120-volt, 50-60 cycle power source. This will ground the amplifier as well as supply power to it. A pilot light on the NTB250 front panel indicates that power has been supplied to the amplifier.

It is advisable to ground the amplifier. Therefore, if a three-wire wall outlet is not available or if the preamp is not equipped with a three-wire power receptacle, an adapter such as Leviton No. 5017 should be used to convert a standard two-wire outlet for use with three-wire plugs. The adapter is provided with a grounding pigtail which should be connected to the screw holding the wall plate to the receptacle.

NOTE

If the wall plate screw is not grounded or if an adapter is not available, connect a ground wire from the GND terminal on the rear chassis of the booster to a water or steam pipe.

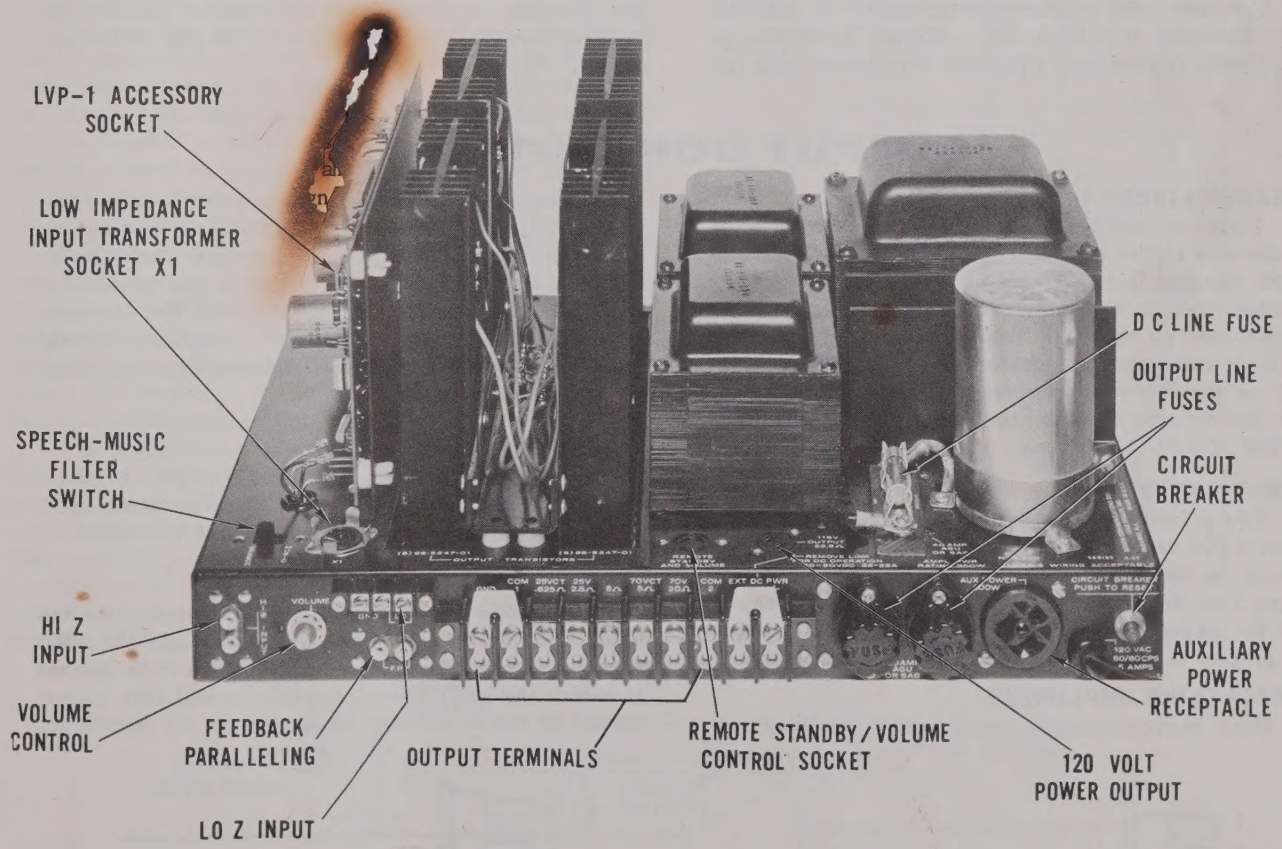


Figure 1 – Rear View of NTB250 Amplifier

AUXILIARY POWER

The auxiliary power receptacle located on the rear chassis (see figure 1) is a three-wire grounded outlet, which can supply power to associated equipment in the sound system. Be sure that the auxiliary component does not draw more than 600 watts. The power switch on the front panel of the amplifier controls this receptacle and can be used to turn the auxiliary unit on and off.

DC POWER

The amplifier may also be powered from an external nominal 24 vdc power source. Power connections are made to the terminal strip located on the rear panel (see figure 1). Remove the link across the EXT DC PWR and connect to a battery or other dc source supplying 20 to 30 volts at between 22 and 32 amperes. The dc power terminals are marked plus and minus. Make sure that the correct polarity is observed when making connections to the dc power supply.

INPUT CONNECTIONS

HIGH IMPEDANCE

Two high-impedance input receptacles are provided on the rear panel (see figure 1). The booster amplifier can be driven to a 250-watt output from any preamplifier or public address amplifier developing 1.4 volts across a 100 K ohm load. A 1.8-volt input is required for the full 350 watt output. The output of the preamplifier is connected to the HI Z INPUT jack on the booster.

LOW IMPEDANCE

For use with low-impedance inputs at 500/600 ohms balanced or unbalanced, a Bogen TL600 plug-in transformer is required. Plug this transformer into the Low-Impedance Input Socket XI on the top chassis of the NTB250. Then connect the low-impedance input from the preamp or P.A. amplifier to the LO Z screw terminal inputs at the rear of the booster. The connection may be grounded by connecting the shield to GND or left floating, depending on whether a balanced or unbalanced input is required.

BRIDGING

The booster amplifier will accept bridging inputs at 10 K ohms, in conjunction with a Bogen TL10K transformer accessory. The transformer is plugged into the XI socket on the NTB250 top chassis. Connect the bridging input to the LO Z input at the rear of the amplifier.

OUTPUT CONNECTIONS

SPEAKER LINES

Terminals are provided on the output barrier strip at the rear of the amplifier for making connections to 8-ohm speaker lines as well as to 70-volt and 25-volt constant-voltage lines, balanced or unbalanced. Make connections as shown in Table I for the impedance or constant-voltage output desired. For detailed information on the installation of multiple speaker systems, see the Speaker Installation Bulletin No. 54-5001-02 packed with the amplifier.

POWER OUTPUT

The polarized receptacle on the top chassis provides a 120 vac output at selected frequencies for laboratory or industrial applications. A two-prong plug, Bogen Part No. 85-0109-01, is supplied with the amplifier for making connections for this receptacle. Wire the plug to the connecting cable as shown in figure 2.

PARALLELING AMPLIFIERS

Dual high-impedance inputs and F.P. (feedback paralleling) receptacles are provided on the rear panel to facilitate paralleling of amplifiers without wiring. When paralleling amplifiers, interconnect the units as shown in figure 4. Any number of units may be paralleled to provide the desired output power. The interconnecting cable for the HI Z and F.P. receptacles should be standard audio shielded cable with phono type plugs as both ends.

NOTE

Only transformer taps of the same output impedance should be paralleled. It must be borne in mind that paralleling outputs reduces the output impedance.

Be certain the SPEECH-MUSIC switch is in the same position on all amplifiers. Rotate all VOLUME controls to maximum gain position. When it is desired to reduce the volume, each amplifier's VOLUME control should be set to achieve equal gain for all amplifiers.

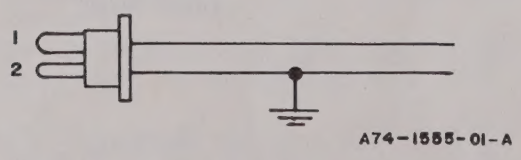


Figure 2 – Wiring Plug for 120-volt Output

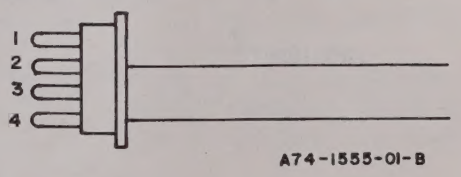


Figure 3 – Wiring Plug for Remote Operation

TABLE I – OUTPUT CONNECTIONS

	Line Connections	Other Connections
8 Ω, Unbalanced	8 Ω, COM 1	Retain link between COM 1 and GND.
8 Ω, Balanced	8 Ω, COM 1	Remove link between COM 1 and GND.
25 V, Unbalanced	25 V, COM 1	Retain link between COM 1 and GND.
25 V, Balanced	25 V, COM 1	Remove link between COM 1 and GND.
25 V, Balanced CT	25 V, COM 1	Remove link between COM 1 and GND,and ground 25 VCT.
70 V, Unbalanced, 250 W	70 V, COM 2	Ground COM 2.
70 V, Balanced, 250 W	70 V, COM 2	- - - -
70 V, Balanced CT, 250 W	70 V, COM 2	Ground 70 VCT.
70 V, Unbalanced, 350 W	70 VCT, 25 V	Connect link between COM 2 and 8 Ω, remove link between COM 1 and GND, and ground 25 V.
70 V, Balanced 350 W	70 VCT, 25 V	Connect link between COM 2 and 8 Ω. Remove link between COM 1 and GND.

REMOTE STANDBY AND VOLUME CONTROL

A four-prong plug, Bogen Part No. 85-0147-02, is furnished with the booster amplifier for use in making connections for remote operation. A Bogen LVP-1 accessory and a SPST switch, neither of which are supplied with the amplifier, are required for remote standby operation. The LVP-1 and RVC-2 accessories are needed for remote volume control. The four-prong plug is wired to the control cable as shown in figure 3 and connected to the REMOTE STANDBY AND VOLUME socket on the top chassis.

To provide remote standby operation, plug the LVP-1 accessory into the LVP socket on the electronic component board. Then mount the SPST switch at a convenient remote location, and make connections to the booster amplifier as shown in figure 5. The switch is used to turn the amplifier output on and off by controlling the input signal. Power will continue to be applied to the booster when the switch is off.

For remote volume control, a Bogen RVC-2 accessory, which is not supplied with the amplifier, is used in place of the SPST switch. The LVP-1 accessory is plugged into place on the electronic component board and connections are made to the amplifier as shown in figure 5. The RVC-2 control can then be used to regulate the output level of the NTB250 amplifier.

For additional information, see the Installation Instruction sheet furnished with the LVP-1 accessories. The length of the control cable which can be used between the remote switch or remote control and the amplifier is limited by the dc resistance of the control leads. The total length of the control cable should not exceed 3,000 feet if No. 22 AWG wire is used or 8,000 feet with No. 18 wire.

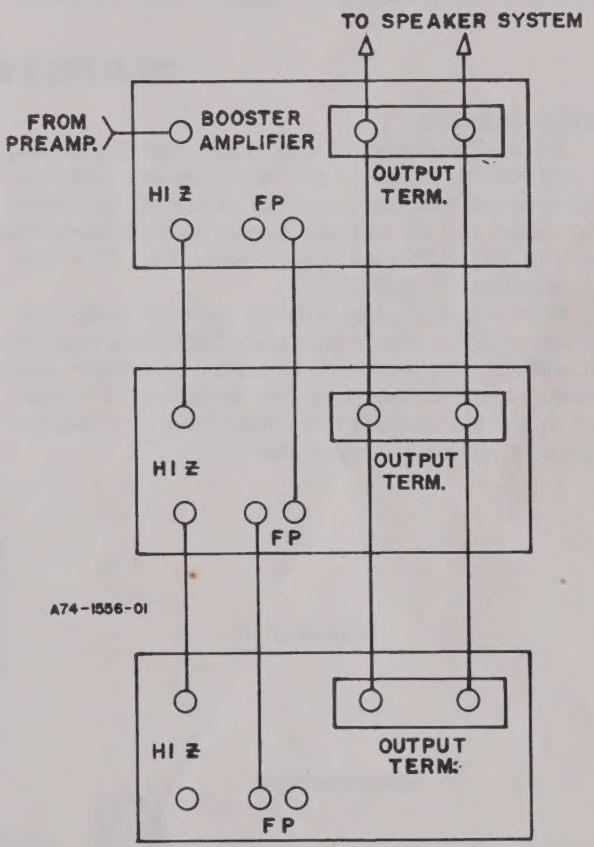


Figure 4 – Paralleling Booster Amplifiers

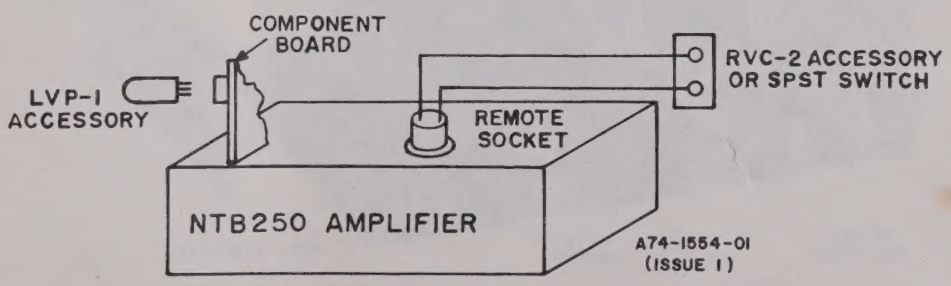


Figure 5 – Connections for Remote Installation

CONTROL FUNCTIONS

The POWER switch, power-on indicator and OUTPUT LEVEL meter are located on the front panel of the booster amplifier (see figure 6). The VOLUME control will be found on the rear panel and the SPEECH-MUSIC filter switch on the top chassis of the unit and are located in figure 1.

The VOLUME control is used primarily to compensate for variations in pre-amplifier output levels. Thus, if the preamplifier output is very high, the user will find that it is necessary to operate the preamplifiers volume control near minimum to prevent "blasting" volume output from the speaker system. Conversely, if the preamplifier output is low, the preamplifier's volume control may have to be operated near maximum to achieve sufficient volume.

The VOLUME control on the NTB250 thus permits the user to preset the gain of the amplifier so that the preamplifier's volume control is operated in its mid-range to achieve the desired volume level range. This control, which need be set only once on installation, is a screwdriver adjustment. The OUTPUT LEVEL meter should read in the NORMAL range when the VOLUME control has been properly set.

The SPEECH-MUSIC switch should be set to the SPEECH position to provide optimum speech response.

MAINTENANCE

BOGEN SERVICE

We are interested in your Bogen unit for as long as you have it. If trouble ever develops with your unit, please do not hesitate to ask our advice or assistance. Information can be obtained by writing to Service Department, Bogen Division, Lear Siegler, Inc., P. O. Box 500, Paramus, N. J. 07652.

When communicating with us, give the model number and serial number of your unit. Completely describe the difficulty encountered. Describe the effects each operating control has upon the symptoms of trouble. Include details on electrical connections to associated equipment and list such equipment.

When we receive this information, we will send you service information if the trouble appears to be simple. If the trouble requires servicing, we shall send you the name and address of the nearest Bogen authorized service agency to which you can send your unit for repair.

When shipping your unit, pack instrument well, using a sturdy shipping carton and filler material to prevent damage in transit. Send the amplifier, fully insured and prepaid, via railway express. Do not ship via parcel post unless so instructed. The unit will be promptly repaired and returned to you prepaid.

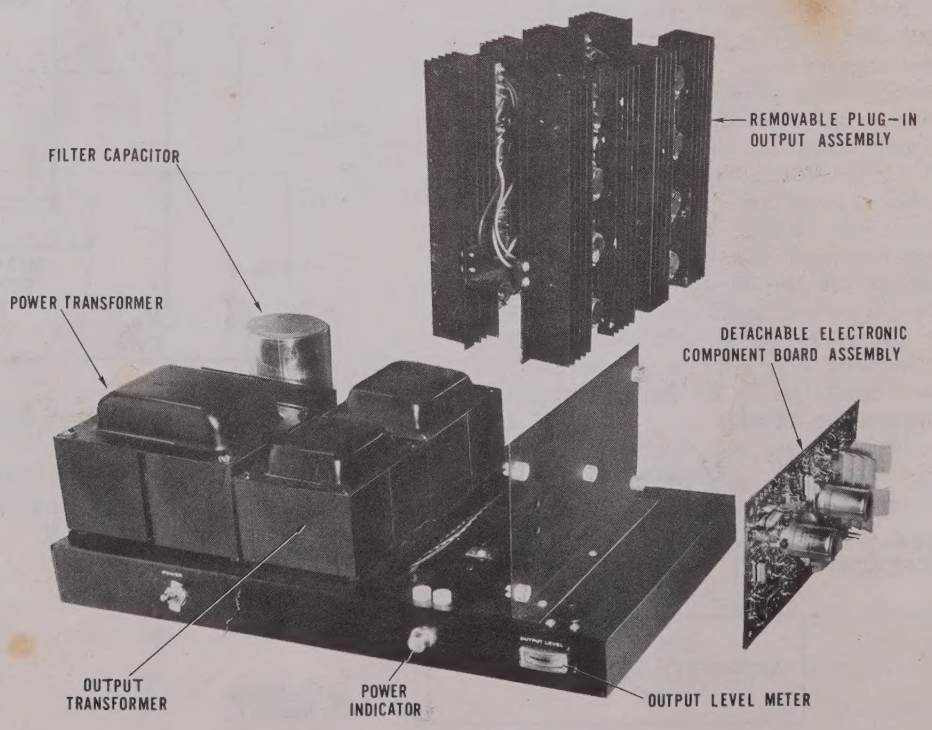
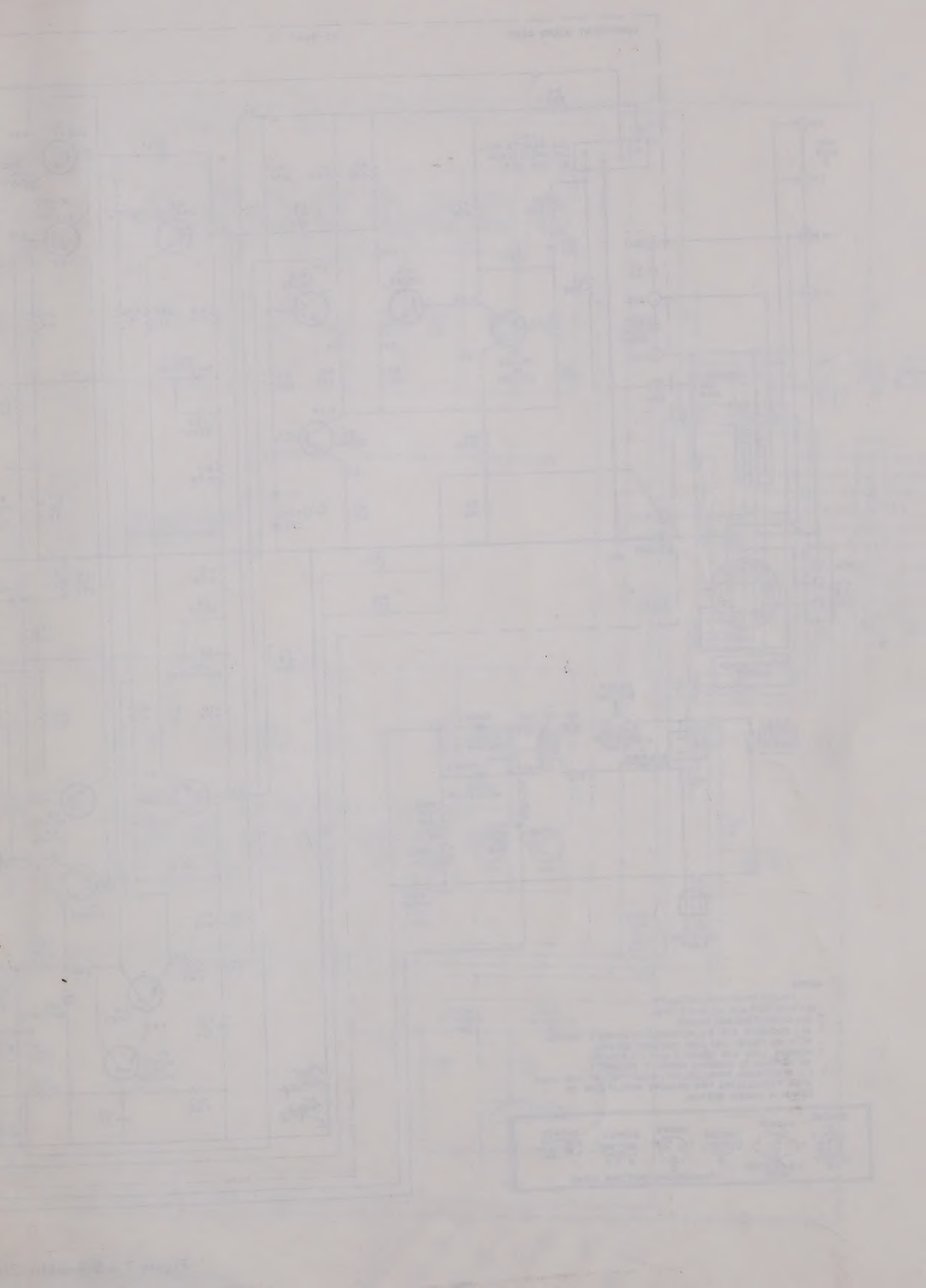


Figure 6 – Top View NTB250 Amplifier with Assemblies Detached



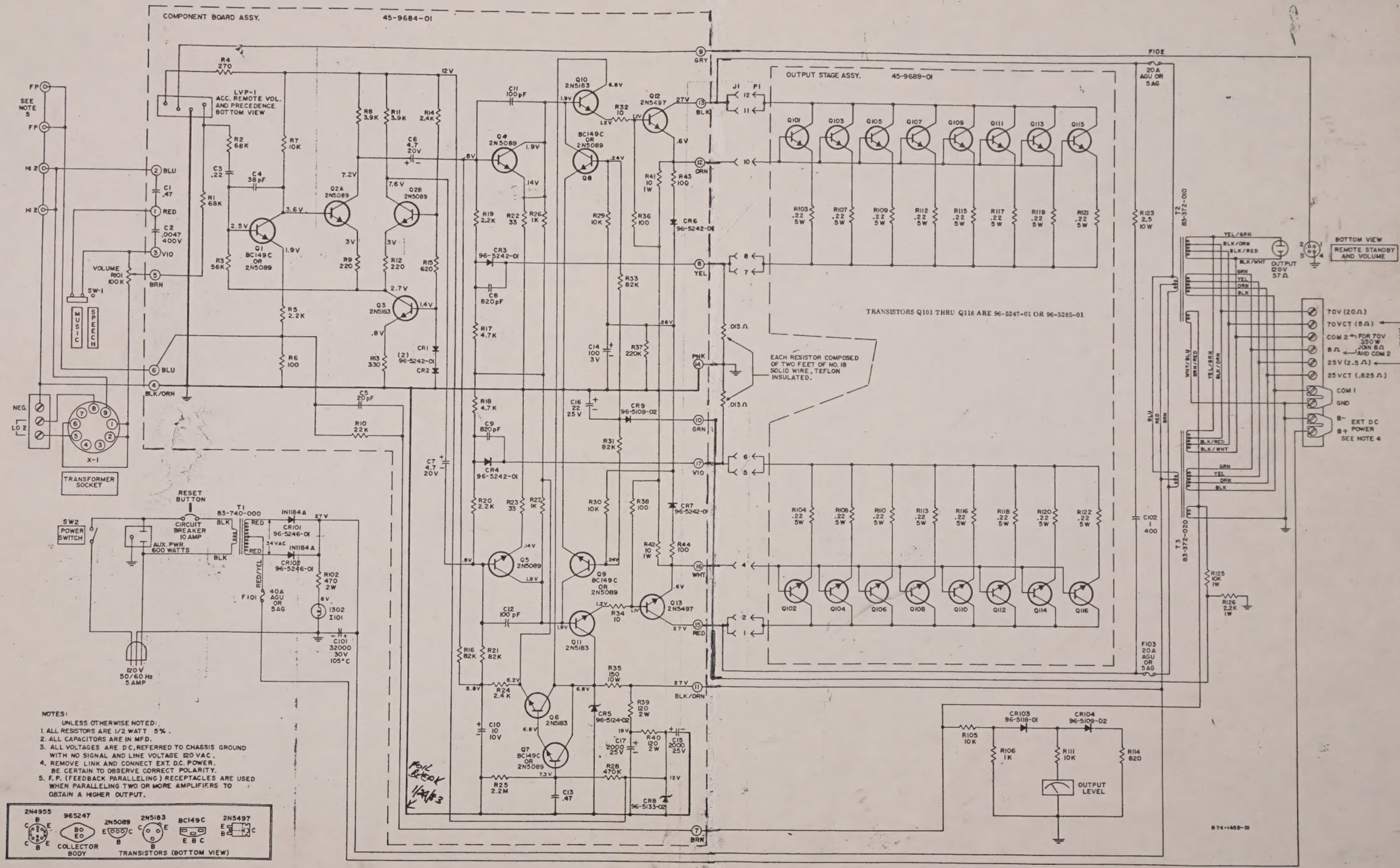
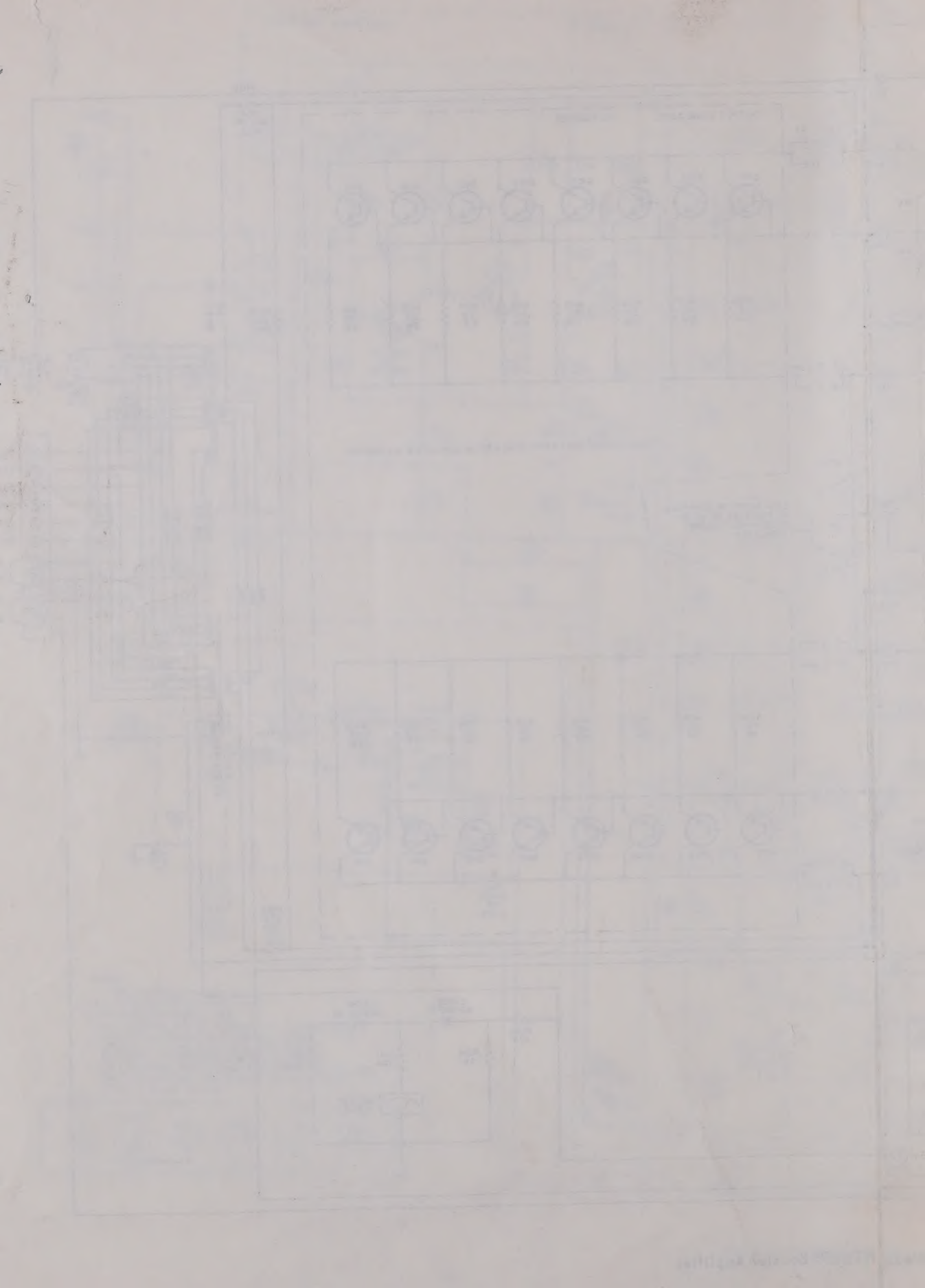


Figure 7 – Schematic Diagram Model NTB250 Booster Amplifier



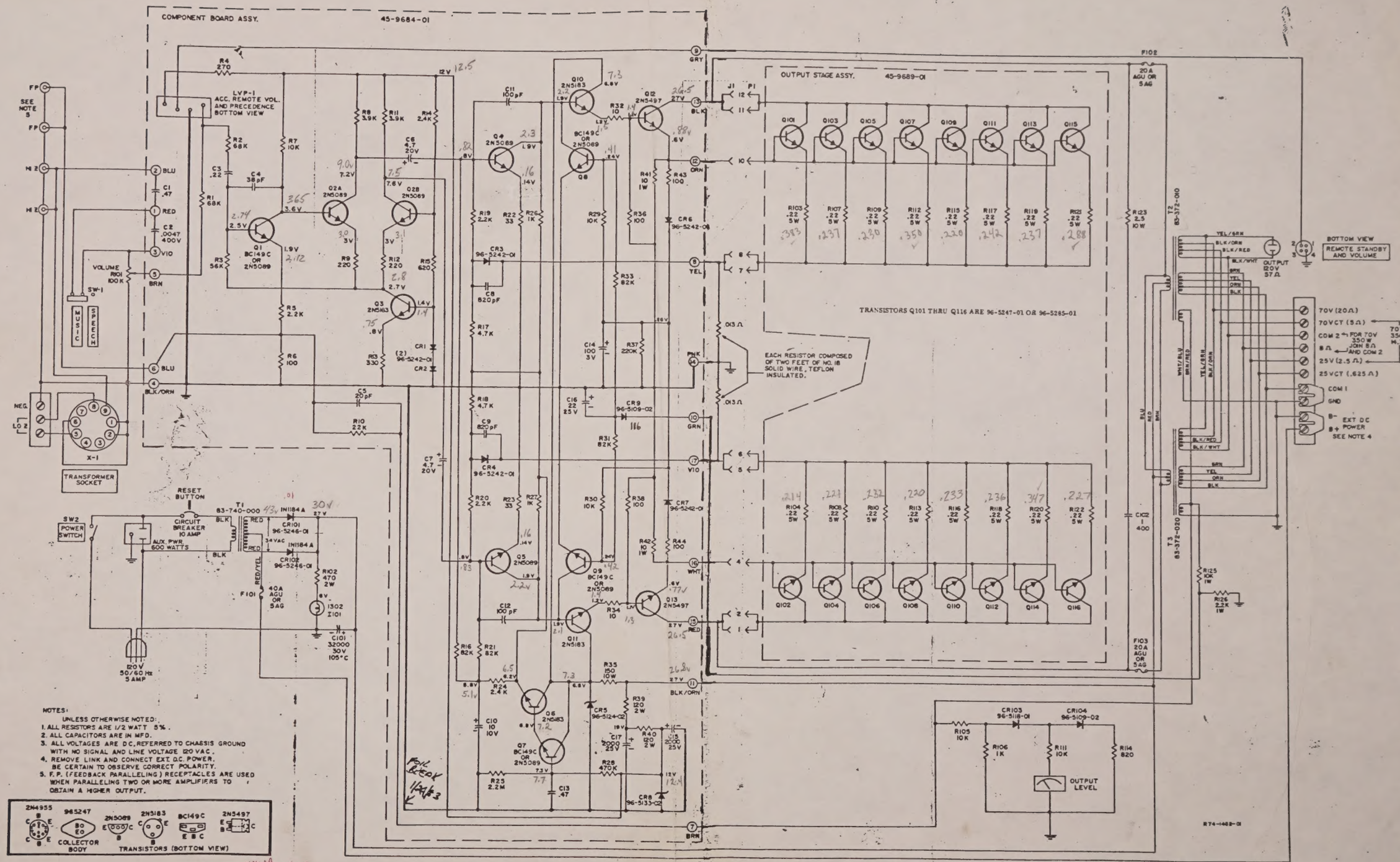

COMPONENT BOARD ASSY. 45-9684-01
OUTPUT STAGE ASSY. 45-9689-01
TRANSISTORS Q101 THRU Q116 ARE 96-5247-01 OR 96-5285-01
EACH RESISTOR COMPOSED OF TWO FEET OF NO. 18 SOLID WIRE, TEFLON INSULATED.
LVP-1 ACC. REMOTE VOL. AND PRECEDENCE BOTTOM VIEW
REMOTE STANDBY AND VOLUME
70V (20Ω)
70VCT (5Ω)
COM 2
8Ω
25V (2.5Ω)
25VCT (.625Ω)
COM 1
GND
B- EXT DC POWER
B+ SEE NOTE 4
70V 350W M.3Ω
FOR 70V 350 W JOIN 8Ω AND COM 2
TRANSFORMER SOCKET
RESET BUTTON
CIRCUIT BREAKER 10 AMP
AUX. PWR. 500 WATTS
SW2 POWER SWITCH
120V 50/60 Hz 5 AMP
OUTPUT LEVEL
MUSIC
SPEECH
VOLUME R101 100K
SW-1
NOTES:
UNLESS OTHERWISE NOTED:
1. ALL RESISTORS ARE 1/2 WATT 5%.
2. ALL CAPACITORS ARE IN MFD.
3. ALL VOLTAGES ARE D.C. REFERRED TO CHASSIS GROUND WITH NO SIGNAL AND LINE VOLTAGE 120 VAC.
4. REMOVE LINK AND CONNECT EXT D.C. POWER. BE CERTAIN TO OBSERVE CORRECT POLARITY.
5. F.P. (FEEDBACK PARALLELING) RECEPTACLES ARE USED WHEN PARALLELING TWO OR MORE AMPLIFIERS TO OBTAIN A HIGHER OUTPUT.
2N4955
965247
2N5089
2N5183
BC149C
2N5497
COLLECTOR BODY
TRANSISTORS (BOTTOM VIEW)
SPRAGUE ORANGE DROP MYLAR OR POLYPROPYLENE FOR GOOD AC COUPLING

Figure 7 – Schematic Diagram Model NTB250 Booster Amplifier

REMOVABLE ASSEMBLIES

The Electronic Component Board Assembly and the Output Stage Assembly may be readily removed from the chassis to facilitate servicing as shown in figure 6. The component board is detached by removing five Phillips head screws which fasten it to the mounting plate and disconnecting the push-in wire plugs. The output stage, consisting of the output transistors mounted on an extrudable aluminum heat sink, is detached from the chassis by removing the four Phillips head screws on the heat sink and then unplugging the assembly.

CAUTION

There are no user serviceable parts in the chassis, and no replacement or repair should be attempted except by a qualified service technician.

FUSE REPLACEMENT

In addition to the 10-ampere circuit breaker for the ac power line, a 40-ampere cartridge fuse is located on the top chassis to protect the dc lines (see figure 1). This fuse should be replaced only with a 40-amp AGU or 5AG fuse.

The output lines are also protected by two 20-ampere fuses located on the rear panel and shown in figure 1. These fuses should be replaced with 20-amp AGU or 5AG fuses only. Unscrew the fuse cap and remove the fuse from the holder.

PILOT LIGHT

The power-on indicator light on the front panel utilizes a long-life bulb, which will seldom require replacement. If it should burn out, however, it may be easily replaced. Unscrew the lens cap on the front panel (see figure 6) and remove the lamp. Replace with a 6.3-volt .050 amp miniature lamp, G.E. 1302.

TRANSISTORS

Transistors show little, if any, deterioration with age and, at the present time, are considerably more reliable than the best vacuum tubes. Therefore, some transistors are soldered into equipment like resistors or capacitors. If the set is inoperative, it generally is safe to assume that these transistors have not failed and that the trouble is elsewhere in the equipment.

However, if previous tests indicate that a transistor might be faulty, it must be removed from the circuit for checking. The plug-in transistors in the output state can be easily replaced after detaching the output stage assembly as described above. After removing defective transistor, brush a silicon grease compound such as Dow Corning No. 340 on the heat sink and transistor. Make certain that no foreign matter remains on heat sink or transistor. To insure proper contact, screw down plug-in transistors tightly.

REPLACEMENT PARTS

The components used in Bogen equipment, with exception of items listed below, are standard parts available through most parts jobbers. However, several parts should be replaced only with genuine Bogen parts. These parts are listed here and are available through Bogen distributors, service agencies or directly from the factory.

When ordering a part, specify part number and description of the part as listed below. Specify the model and give the series designation, which is a run letter followed by numbers, stamped or screened on the rear of the chassis. Also, give the component board assembly number (45-) for all parts mounted on PC boards. For reference designations, see the schematic diagram, figure 6.

Ref. No.	Part No.	Description
C101	79-108-002	Capacitor, 32,000μF, 30V, 105C
CR101, 102	96-5246-01	Diode, Silicon Rectifier
CR103	96-5118-02	Diode, 15 PIV, 30 ma
CR104	96-5109-02	Diode, 150 PIV, 100 ma
F101	94-0006-06	Fuse, 40 A, 32 V
F102, 103	94-0006-04	Fuse, 20 A, 32 V
I101	94-0222-01	Lamp, Power Indicator
R101	77-001-605	Volume Control, 100 K Ω
R123	76-121-002	Resistor, 2.5 Ω, 10 W
T101	83-740-000	Transformer, Power
T102	83-372-010	Transformer, Output
T103	83-372-020	Transformer, Output
	85-0147-02	Plug, Remote Standby & Volume
	85-0109-01	Plug, Polarized, 120 V Output
	70-9166-01	Link, Output Terminal Strip

ELECTRONIC COMPONENT BOARD ASSEMBLY
Part No. 45-9684-01

C6, 7	79-504-040	Capacitor, Tantalum 4.7μF, 20V
C10	79-504-048	Capacitor, Tantalum, 10μF, 10 V
C14	79-508-002	Capacitor, Tantalum, 100μF, 3 V
C15, 17	79-106-003	Capacitor, Electrolytic, 2000μF, 25 V
CR1-4, 6, 7	96-5242-01	Diode, Stabistor, Silicon
CR5	96-5124-02	Diode, Xener, 6.8 V
CR8	96-5138-02	Diode, Zener, 12 V
CR9	96-5109-02	Diode, Silicon 150 PIV
Q1, 7, 8, 9	96-5229-01	Transistor, BC149C
Q2A, 2B, 4, 5	96-5213-01	Transistor, 2N5089
Q3, 6, 10, 11	96-5244-01	Transistor, 2N5183
Q12, 13	96-5245-01	Transistor, 2N5497
R42	76-121-001	Resistor, 150 Ω, 10 W

OUTPUT STAGE ASSY., PART NO. 45-9689-01

Q101-116	96-5247-01 or 96-5285-01	Transistor
R101-116	76-113-098	Resistor, 0.22 Ω, 5 W

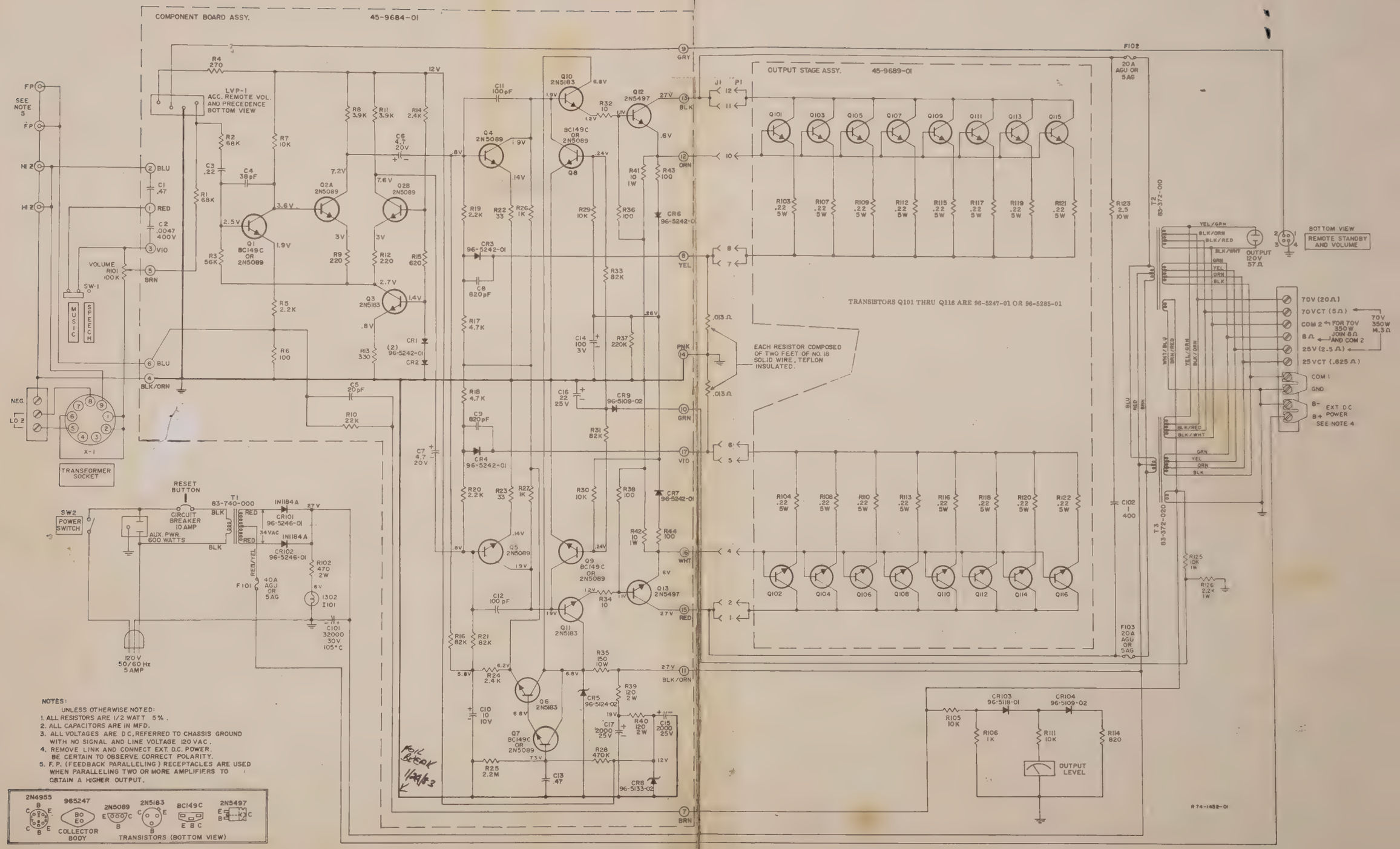


Figure 7 – Schematic Diagram Model NTB250 Booster Amplifier

OWNER'S WARRANTY

Bogen solid state sound equipment is guaranteed against defects in material and workmanship for one year from the date of sale to the original purchaser, provided that the equipment has not been subjected to abuse or accident or altered in any way. Any part of the equipment covered by this warranty which, with normal installation and use, becomes defective will be repaired or replaced by Bogen, provided the equipment is delivered or shipped prepaid and insured to our authorized service station or to the Bogen Factory Service Department, Route 4 and Forest Avenue, Paramus, New Jersey 07652. The equipment may be picked up by you personally or will be returned to you freight prepaid.

Models containing vacuum tubes carry the same warranty as above, except that it does not apply to the vacuum tubes, which are guaranteed for 90 days.

The registration card enclosed with the equipment must be completed and mailed within five days of purchase to place the warranty in effect.

LEAR SIEGLER, INC.

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BOGEN DIVISION
P.O. BOX 500
PARAMUS, N. J. 07652

PRINTED IN U.S.A.

54-5461-04

D.C. AMPLIFIER MODEL BL-932

DESCRIPTION

D.C. Amplifier Model BL-932 (Figure 1) has been developed primarily for use with Magnetic Direct Inking Oscillographs, Model BL-201, BL-202 and BL-206, to maintain a relatively flat response from d-c to 100 cps. The amplifier consists of five stages of amplification, a calibrating circuit, and an electronically regulated power supply for 100 to 125 volts 60 cycle operation. The amplifier circuit incorporates direct coupling between all stages. The first and second stages of the amplifier utilize a self-balancing circuit in which one tube is balanced against another to minimize the effects of drift and power supply regulation.

A calibrating circuit is included in the amplifier so that the pen deflection of the oscillograph can be accurately correlated to the input voltage of the amplifier.

The control panel at the top of the instrument contains a calibrating meter, balance control (a potentiometer of unique design allowing a total angular rotation of 3600°), gain control, attenuator, calibrating button, and calibrating voltage control (Figure 2). The back plate assembly of the amplifier carries the "ON-OFF" toggle switch, a 4-prong female connector, power plug, fuse holder, and a binding post for an external ground connection (Figure 3). The input jack is found at the front of the amplifier.

Figure 1

The case can be slipped off upon removing the screws from the bottom. In addition, there are four rubber feet at the rear of the chassis in order that the amplifier can be set vertically.

MP MASTER
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SPECIFICATIONS D.C. AMPLIFIER MODEL BL-932

Input voltage range ..... .001 to 200 volts

Output voltage ..... 15 volts (max. rms)

Input impedance ..... 9 megohms

Output impedance ..... Approximately 50 ohms (not to be loaded with less than 1500 ohms)

Power required ..... 100 to 125 volts, 60 cycles, 125 watts

Dimensions ..... 17¼" long x 11" wide x 7½" high

Net weight ..... 34 pounds

Shipping weight ..... 38 pounds

Tubes required ..... Two matched 6F5 tubes, Brush Part No. 102708-4 (for use in first stage only), two matched 6F5 tubes No. 102708-3 (for use in second stage), two 6F5, No. 102708-2, one 5U4G, one VR-150, two VR-105, one 6AS7, one 5651, one 6SL7, one 6V6.

Fuse ..... 2 ampere "Littelfuse" type 3 AG or equivalent

Frequency response of amplifier and oscillograph .. d-c to 100 cps.

Sensitivity ..... 1 chart mm per millivolt

Stability ..... Less than 1 chart mm per hour

OPERATION

The Model BL-932 Amplifier can be connected directly to BL-201 or BL-202 Oscillograph by means of the output cable connector. If the amplifier is to be used with the penmotor alone, the penmotor leads should be connected to prongs numbers 1 and 3 (or 4) of the 4-prong male collector on the cable furnished with the amplifier. With the "ON-OFF" toggle switches of both the amplifier and oscillograph in the "OFF" position the power cable should be connected to a 115 volt, 60 cycle supply. (note: no other line frequency can be used with this amplifier). In some cases it may be necessary to ground the chassis at the binding post at the rear of the amplifier. Set the attenuator switch on the control panel of the amplifier at the "100" position, turn on the amplifier and allow to warm up. For maximum stability and minimum drift, a warm-up period of one hour is recommended before measurements are attempted.

Turn on the oscillograph and with the chart running on the slow or medium speed (see Sec. II), center or otherwise position the pen on the chart as desired by means of the "balance" or pen positioning control of the amplifier (Figure 2).

For work where impulses of both signs are to be recorded, the pen is usually centered on the chart. However, where signals of one polarity only are encountered, it is sometimes advantageous to position the pen to one side of the chart so that advantage may be taken of the total width (40 mm) of the chart. When making this adjustment, there should be no input signal to the amplifier. The input to the amplifier is supplied by means of a phone plug inserted in the jack located at the front of the amplifier (Figure 2). The attenuator should be moved to a position where the signal under observation causes a deflection not exceeding 20 mm either side of center (or 40 mm. overall); fine sensitivity adjustments are made by means of the "gain" potentiometer located on the control panel of the amplifier (Figure 2).

When adjusting the gain of the instrument, the user will notice that it is possible, by adjusting the gain potentiometer alone, to reduce the sensitivity to any desired point, regardless of attenuator setting. In other words, a relatively large signal, say 1.0 volt, can be measured on the .001 attenuator tap by reducing sensitivity with the gain control. It is recommended, however, that where possible, the amplifier be operated with the attenuator setting on that position which is consistent with the magnitude of the input signal. The gain control is then used for fine adjustments only, which simplifies calibration measurements.

In certain kinds of work it is necessary to measure small changes in a variable superimposed on a much larger steady state condition. Examples of this are the recording of small voltage changes in batteries, or the measurement of light, temperature, or pressure transients occurring on an ambient condition of greater magnitude. There are two methods of recording these variables with the BL-932 Amplifier and the Brush Oscillograph. If possible, the steady state d-c component should be bucked or cancelled by an equal and opposite voltage prior to amplification. However, in certain cases it is feasible to compensate for this steady state voltage by means of the "balance" control on the amplifier, providing the variations are not less than approximately 20% of the total voltage. In making such measurements, the attenuator should be set on an insensitive position to start with, and the "balance" control adjusted at each more sensitive attenuator step until the pen is properly positioned on the chart. Changes made in the gain control setting will also require correction of the "balance" to keep the potentiometer pen on the chart. This method is not suitable for bucking steady state voltage greater than about five times the variation of interest, since larger ratios will cause the amplifier response to be non-linear.

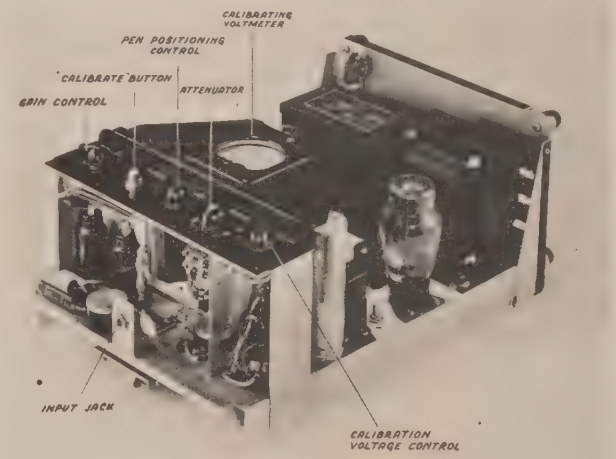

Figure 2

The D.C. Voltmeter, "Calibrate"

button, and "Cal. Voltage" control (Figure 2) are used for setting the gain of the amplifier to provide any desired overall calibration (in peak volts input per chart division pen deflection). They may also be used to determine the peak value of the input signal at any arbitrary gain setting. Methods of using these controls (which are similar to those provided in the BL-905 amplifier) are described in Sec. III, Operating Information. Calibration of the BL-932 is made independent of line voltage fluctuations and r.m.s. equivalent calculations through the use of a regulated DC Voltage source wherein the amplifier gain is adjusted so that 10 mv input gives 10 lines per deflection on the .001 scale. The calibrator scale is extended to 25 mv to permit accurate calibration up to 25 lines pen deflection where desired.

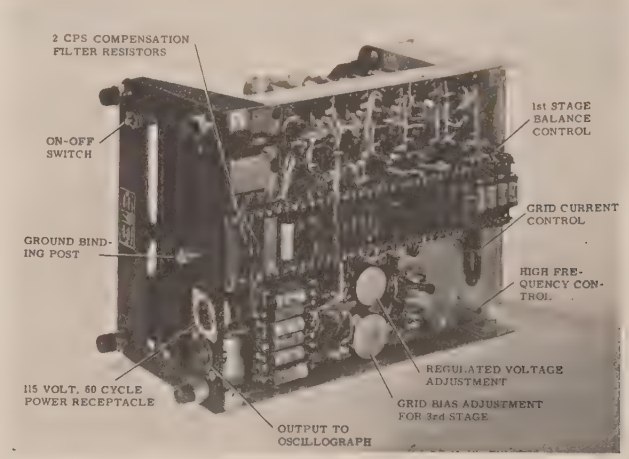

Figure 3

When tested at the factory, the BL-932 Amplifier is adjusted to provide the most uniform response in the range from d-c to 80 cps. In general purpose work where both steady state and dynamic signals of moderate frequencies are encountered, this provides optimum service condition. In some cases, however, it is necessary to record square waves or step functions where it is vital to minimize pen overshoot. It is possible to practically eliminate overshoot by changing slightly the frequency response mentioned above. This is done as follows. First, apply to the input of the amplifier a known voltage at frequency of 20 cps and adjust the gain control until a pen deflection of 10 mm overall is obtained at medium or high chart speed. Next, an input signal of the same magnitude at 80 cps. is substituted. The high frequency compensating control (opening for screw driver adjustment found underneath amplifier case nearest right front rubber foot (Figures 3 and 4), is turned until a pen deflection of about 7.5 mm overall is produced. Return to a 20 cps signal and readjust the gain control, if necessary, until the 10 mm band width is again obtained. The 80 cps. signal is again applied and the high frequency control adjusted to produce the 7.5 mm trace. Repeat this procedure until an adjustment is no longer necessary.

The same procedure is used for adjusting a given amplifier and penmotor for uniform response, except that *equal* band widths at 20 and 80 cycles should be obtained. Individual penmotors may vary slightly in their characteristics so that the above adjustments should be made in conjunction with the particular penmotor or oscillograph with which the amplifier will be used. If for any reason, a different penmotor is substituted, the above frequency check should be made.

When the amplifier is matched with oscillographs other than those used for alignment at the factory it may occasionally be found that the frequency response in the vicinity of 2 cps is outside the normal limits of 9½ to 10½ lines. In this case, compensation may be effected by altering the feedback loop filter. One or both sections (or neither) may have been connected at the factory for best response with the oscillograph to which the amplifier was matched. This filter may be matched to any other oscillograph in a similar manner. Adding filter sections will lower the relative response at 2 cps; removing sections will raise it.

The two 100K resistors of the filter are located on terminal sets four and five from the rear of the unit, on the large terminal board underneath the unit.

Connecting the free terminal of one 100K resistor to terminal 6 (50 K 10 watt resistor, fuse side of board) puts one filter section in the circuit. Connecting both 100K resistor free terminals to terminal 6 puts both filters in the circuit. With neither 100K resistor so connected, there is no filter in the circuit.

It is important that the attenuator be set at "100" prior to removing or inserting the input plug to the amplifier. Also, since the input plug is momentarily short circuited when removed or inserted, care should be taken that no high voltage or low impedance sources be left connected to the plug while it is being removed or inserted.

It is advisable to turn off first the oscillograph and then the amplifier before disconnecting the cables between the two units.

MAINTENANCE

A. Most of the service information is contained in the schematic diagram furnished with each amplifier.

B. Replacement of tubes in the first and second stages of the amplifier (see specifications) must be made with tubes aged and matched at the factory. A re-balance of the amplifier will be necessary and can be effected in the following manner:

Short the grid of the tube in the third stage to chassis ground and adjust bias of that stage (25 K potentiometer, See Figures 3 and 4) until the pen of oscillograph connected to the amplifier is centered. Remove the connection from the grid to chassis ground and vary the power supply voltage to the amplifier from 110 to 130 volts with a Variac or similar device. If the pen is displaced more than ½ mm, adjust 5K potentiometer (see Figure 4) in cathode circuit of input tube and again vary the power supply voltage.

C. To balance out possible grid current in input tube, proceed as follows:

Slowly vary gain control (10 megohm potentiometer) at the .001 attenuator setting. If a pen displacement greater than ¼ mm is indicated on the oscillograph, adjust setting of 3,000 ohm potentiometer mounted on front end of amplifier chassis (opening for screw driver adjustment found in bottom of case —second hole from rubber foot at your right [Figure 4]), and again vary gain control at the .001 attenuator setting.

D. If it is desired to check the accuracy of the calibrating circuit adjustments, the following procedure must be followed:

1. Apply to the input of the amplifier a known 10 mv dc signal.
2. Adjust gain control to deflect oscillograph pen 10 mm.
3. Press calibrating button and adjust calibrating voltage so that meter reads 10. Do not change gain control.

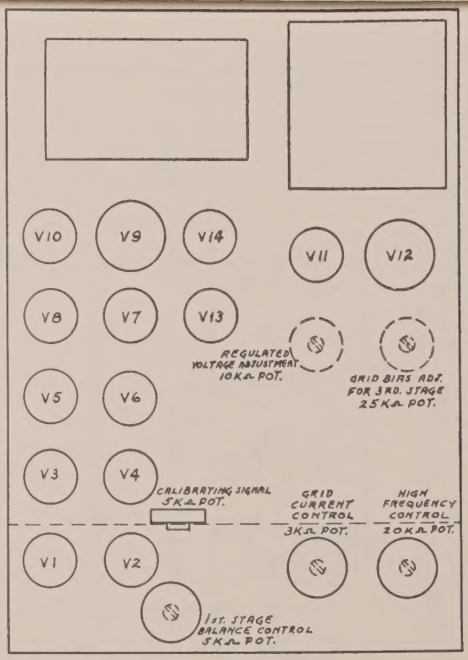

Figure 4

4. With meter set on 10 as in step 3, adjust the 5K calibrating signal potentiometer for 10 mm. chart deflection of the oscillograph pen (see Figure 4).
5. Calibration may also be made, if desired, against a standard cell (Weston—1.0183v) provided required pen deflection from center is modified accordingly. Use 0.1 attenuator tap. The standard cell may be applied directly to the input due to the high input impedance (10 meg.) of the BL-932.

E. Inasmuch as the amplifier is a finely balanced and sensitive instrument, occasionally transitory vibrations or shocks may disturb somewhat the balance of the amplifier. This may necessitate a re-setting of the balance control.

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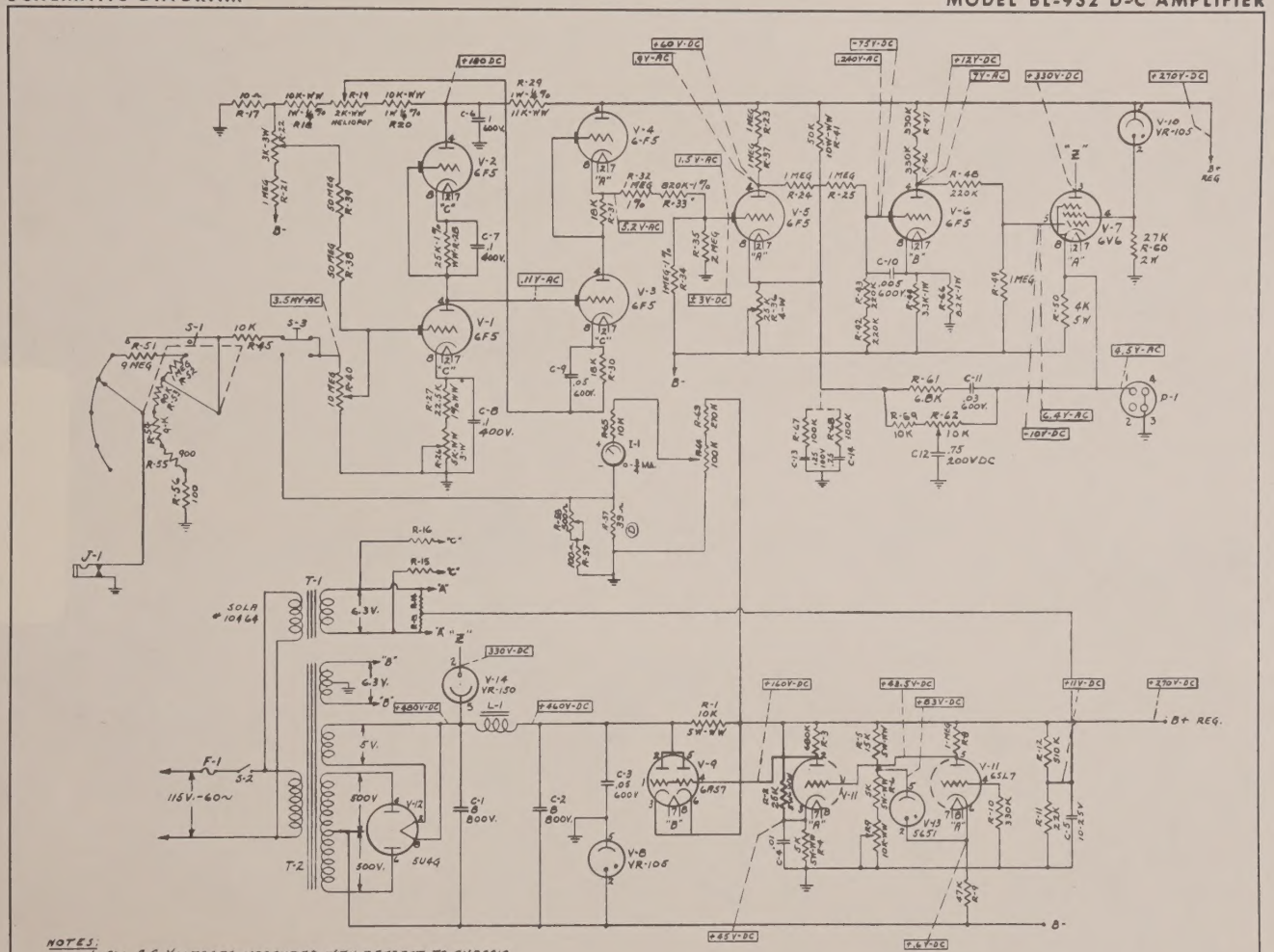

NOTES:
1- ALL A.C. VOLTAGES MEASURED WITH RESPECT TO CHASSIS TAKEN WITH BALLANTINE V.T.V.M. USING X10 MULTIPLIER (3 MEG. INPUT) READINGS OBTAINED WITH 3.5 MV. R.M.S. INPUT AT 20 C.P.S. OUTPUT ADJUSTED FOR 3.5 V.-R.M.S.
2- ALL D.C. VOLTAGES MEASURED WITH RESPECT TO CHASSIS TAKEN WITH VOLT OHMYST JR. V.T.V.M. (11 MEG. INPUT)

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